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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

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TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

WATER FILTERER (waterworks) 7-54.621

B-403 or S-139

TM 001 527

U. S. Employment Service in
Cooperation with
Colorado State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
December 1958

GATB #2201
January 1958

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR WATER FILTERER 7-54.621

B-403 or S-139

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 51 men employed as Water Filterer 7-54.621 by the Water Department of Denver, Colorado. The criterion consisted of supervisory ratings. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis and their combined selective efficiency Aptitudes G-Intelligence, N-Numerical Aptitude, and Q-Clerical Perception were selected for inclusion in the test norms.

GATB Norms for Water Filterer 7-54.621 - B-403 or S-139

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Water Filterer 7-54.621.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-403 or S-139

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	75	G	Part 3 Part 4 Part 6	70
N	CB-1-D CB-1-I	85	N	Part 2 Part 6	80
Q	CB-1-B	75	Q	Part 1	80

Effectiveness of Norms

The data in Table IV indicate that 12 of the 17 poor workers, or 71 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 71 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 26 of the 31 workers who made qualifying test scores, or 84 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Water Filterer 7-54.621.

II. Sample

During the period October 21, 1957 to January 3, 1958, the General Aptitude Test Battery, B-1002A, was administered to 51 men employed as Water Filterer 7-54.621 by the Water Department of Denver, Colorado. The selection of the sample was on a volunteer basis. All of the tested workers were included in the final sample.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education, and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and
Pearson Product-Moment Correlations with the Criterion (r)
for Age, Education, and Experience

Water Filterer 7-54.621
N = 51

	M	σ	Range	r
Age (years)	49.9	10.4	24-67	-.224
Education (years)	9.8	1.7	7-14	.053
Experience (months)	214.3	136.9	16-507	.065

There are no significant correlations between age, education, and experience. The data in Table II indicate that this sample represents a wide range of age, education, and experience. However, the distributions are probably fairly typical, and the data indicate that this sample is suitable for test development purposes with respect to age, education, and experience.

III. Job Description

Job Title: Water Filterer 7-54.621

Job Summary: Operates a filter plant by determining and changing filtration rates, testing water samples, controlling dry chemical machines and chlorinators, observing and recording meter and gauge readings, and washing filters when necessary.

Work Performed: Tests water samples and records results: Runs tests on raw and finished water at start of each shift. Uses testing equipment and own sense of smell, taste, and vision to check the turbidity, alkalinity, PH chlorine residual, taste and odor of influent and effluent samples. Makes periodic tests during course of shift. Records results of tests on prescribed form.

Fills and regulates chemical machines: Refills dry feed chemical machines before going off shift. Determines the amount of chemicals that will be needed to fill hoppers. Uses fork lift to convey sacks of chemicals from warehouse to hoppers. Opens and lifts 100 lb. sacks that contain alum, aluminum silicate, lime, and charcoal, and dumps in the specified machine. Replaces chlorine tanks as needed on chlorine machine, and checks all connections for leaks.

Adjusts feed regulator on each dry feed chemical machine to dispense the proper amount of dosage in accordance with the amount of raw water intake and any other conditions that would affect the raw water.

Records hourly the output and operations of chemical machines on a prescribed form.

Controls filtration operations: Checks central control panel gauges and meters at frequent intervals to be assured that the filtration system is functioning properly. Checks control panel whenever warning horn sounds to determine location of malfunction which is reflected on control panel. Makes the necessary adjustments to correct malfunctions or contacts maintenance mechanic or foreman whenever the malfunction or breakdown requires an experienced mechanic.

Reads and records readings of meters and gauges on control panel.

Controls quality of finished water: Makes periodic checks of all operating filters to be assured that the quality of finished water meets the required standards.

Takes a sample of water at regular intervals from Filter Outlet and tests its quality.

Backwashes filters that are producing substandard water by operating hand valves on control box to reverse flow of water in filter beds. Closes and opens valves when backwash is completed to restore filters to normal operations. Records date and time of backwash on prescribed form located at each filter.

IV. Experimental Battery

All the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion used for this study consisted of an equally weighted composite score consisting of average ratings on the Descriptive Rating Scale and the numerical scores corresponding to combined broad category ratings made by the two supervisors.

Two first line supervisors independently rated each worker on the Descriptive Rating Scale. The two supervisors also prepared independent broad category ratings for each worker. A correlation coefficient of .73 was obtained between the two sets of ratings made on the Descriptive Rating Scale and .48 between the two sets of broad category ratings. The two sets of Descriptive Rating Scale ratings were averaged. The two sets of broad category ratings were combined. The new broad categories formed and the numerical score for each category are shown below.

Category	N	Numerical Score
AA	6	67
AB	19	55
AC	4	49
BB	4	47
BC	7	44
CC	11	36

A correlation coefficient of .76 was obtained between the averaged Descriptive Rating Scale ratings and the combined broad category scores. Application of the Spearman-Brown Prophecy formula raised that correlation coefficient to .86. Considering this degree of agreement between the two different ratings, an equally weighted composite score was formed which consisted of the averaged Descriptive Rating Scale ratings and the combined broad category ratings made by the two supervisors. This composite score was used as the final criterion for validation purposes.

VI. Statistical and Qualitative Analyses

A. Statistical Analysis:

Table III shows the means, standard deviations, and Pearson product-moment correlations with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Water Filterer 7-54.621
N = 51

Aptitudes	M	σ	r
G-Intelligence	93.0#	16.2	.438**
V-Verbal Aptitude	94.1#	15.2	.301*
N-Numerical Aptitude	90.0#	14.6	.358**
S-Spatial Aptitude	89.8#	19.4	.407**
P-Form Perception	76.5	16.3	.441**
Q-Clerical Perception	85.7	11.0	.458**
K-Motor Coordination	80.5	21.5	.276*
F-Finger Dexterity	77.5	21.5	.303*
M-Manual Dexterity	76.5	19.8	.276*

**Significant at the .01 level
*Significant at the .05 level
#Highest mean scores

B. Qualitative Analysis:

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation.

Intelligence (G) - required to learn and understand the techniques, the processes, the sequences of operations, and the properties of the various materials.

Numerical Aptitude (N) - required in figuring amounts of material to be used in ratio to intake, and compensations to be made in order to maintain consistency of product.

Clerical Perception (Q) - required in noting fluctuation indicated on charts, and reading of gauges.

Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (M) - required to manipulate testing equipment, to use fork lift in conveying sacks of chemicals, to open and left sacks of materials, and to make minor mechanical adjustments.

C. Selection of Test Norms:

Based on the quantitative and qualitative evidence cited above, Aptitudes G, N, S, and Q warranted further consideration for inclusion in the test norms. The evidence for each of these aptitudes is indicated below.

Aptitude	High Mean Score	Significant Correlation with the Criterion at .01 Level	Importance as Indicated by Qualitative Analysis
G	X	X	X
N	X	X	X
S	X	X	
Q		X	X

Although Aptitude V showed the highest mean score for the sample, Aptitude P had a correlation with the criterion significant at the .01 level, and Aptitudes K, F, and M appeared to be important on the basis of the job analysis data, these aptitudes were not considered further for inclusion in the norms because there was not sufficient qualitative or quantitative evidence of significance.

NOTE: Since all of the aptitudes showed significant correlations with the criterion at the .01 or .05 level of confidence, those aptitudes which correlated significantly with the criterion at the .01 level of confidence were selected for further consideration on the basis of significant correlations.

Various combinations of Aptitudes G, N, S, and Q, with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in Section VII was determined.

A comparison of the results showed that norms consisting of G-70, N-80, and Q-80 for B-1002 and equivalent norms of G-75, N-85, and Q-75 for B-1001 had the best selective efficiency.

In test development studies an attempt is made to develop a set of norms such that the cutting score for each aptitude included in the norms will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In this study the aptitude cutting scores are each within 10 points of one standard deviation below the aptitude mean of the sample.

VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized by placing one-third of the sample in the low criterion group. This was accomplished by setting a criterion critical score of 11, which resulted in 17 of the 51 workers being placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes G, N, and Q with critical scores of 70, 80, and 80 respectively, and the dichotomized criterion for Water Filterer 7-54.621. Workers in the high criterion group have been designated as "good workers," and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes G, N, and Q with Critical Scores of 70, 80, and 80 Respectively, and the Criterion for Water Filterer 7-54.621

N = 51

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	8	26	34
Poor Workers	12	5	17
Total	20	31	51

$r_{tet} = .68$ $\quad X^2 = 8.647$

$\sigma_{r_{tet}} = .23$ $\quad P/2 < .005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes G, N, and Q with minimum scores of 70, 80, and 80 respectively, are recommended as B-1002 norms for the occupation of Water Filterer 7-54.621. The equivalent B-1001 norms consist of G-75, N-85, and Q-75.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Since none of the existing 23 occupational aptitude patterns meets these criteria, the selective efficiency of any existing occupational aptitude pattern was not determined for this sample. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.